

Riemannian Optimization on Tree Tensor Networks with Application in Machine Learning

Marius Willner
Augsburg University
`marius.willner@uni-a.de`

Tensor networks, originally developed for low-rank approximation and quantum simulations, have recently peaked interest as promising tools for kernel learning tasks. In this poster, we present a formal differential-geometric framework for tree tensor networks (TTNs) based on its quotient manifold structure, and show how it leads to efficient first- and second-order optimization algorithms. We also introduce a backpropagation algorithm for kernel learning with TTNs and share some experimental results from a representative machine learning task.

Joint work with: Marco Trenti, Dirk Lebiedz.

References

- [1] Marius Willner, Marco Trenti, Dirk Lebiedz: Riemannian Optimization on Tree Tensor Networks with Application in Machine Learning, 2025 *arxiv preprint* <https://arxiv.org/abs/2507.21726>